REMARKS

The foregoing amendments are responsive to the August 24, 2006 Office Action. Applicant respectfully request reconsideration of the present application in view of the foregoing amendments and the following remarks.

Please charge any additional fees, including any fees for additional extension of time, or credit overpayment to Deposit Account No. 11-1410.

Response to Rejection of Claim 38 Under 35 U.S.C. 112, First paragraph

The Examiner rejected Claim 38 under 35 U.S.C. 112, first paragraph as failing to comply with the written description requirement. Claim 38 has been canceled.

Response to Rejection of Claim 39 Under 35 U.S.C. 112, Second paragraph

The Examiner rejected Claim 39 under 35 U.S.C. 112, second paragraph as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention. Claim 39 has been amended to more particularly point out and distinctly claims the subject matter Applicant regards as the invention.

Response to Rejection of Claims 1-21 and 34-54 Under 35 U.S.C. 101

The Examiner rejected Claims 1-21 and 34-54 under 35 U.S.C. 101 because the inventions as disclosed in the claims are directed to non-statutory subject matter.

Applicant has amended Claims 1, 2, and 10 to clarify that the results are compressed and thus, the claims recite a concrete, useful, tangible, result; namely, reducing the physical computer resources used for a system of equations. Moreover, the claims do not preempt abstract ideas, laws of nature or natural phenomena. Rather, the claims recite methods for reducing the use of physical computer resources.

Response to Rejection of Claims 1-21, 34-37 and 40-54 Under 35 U.S.C. 102(b)

The Examiner rejected Claims 1-21, 34-37 and 40-54 under 35 U.S.C. 102(b) as being anticipated by Canning et al., Rockwell Inst. Sci. Center, "Fast Direct Solution of Standard

Moment-Method Matrices," IEEE Antennas and Propagation Magazine, June 1998, pages 15-26, hereafter referred to as Rockwell.

Rockwell (Page 16, second column, Equation (3)) uses the Singular Value Decomposition (SVD)

$$A = U\ D\ V^h$$

Rockwell uses an expansion of the SVD (See Rockwell, Page 17, first column, Equation (4)) wherein:

$$A = u_1\ s_1\ v_1{}^h + u_2\ s_2\ v_2{}^h + \ldots + u_p\ s_p\ v_p{}^h$$

The sentence in Rockwell after this equation states, "Here, u_k represents the kth column of U, s_k represents the kth singular value of A (e.g., the kth diagonal element of D), and v_k represents the kth column of V." In Rockwell, the SVD is used to create pairs of new functions, and the k-th pair is (u_k,v_k). Rockwell teaches that the series given above for A may be truncated to use fewer than p pairs of functions, providing an approximation to A.

Consider, for example, the example of applying the teachings of Rockwell to the 1 x 3 matrix A given by

$$A = \begin{bmatrix} 1.0 & 2.0 & 3.0 \end{bmatrix}$$

Then, according to Rockwell on Page 17, first column, Equation (4), A would be given by:

$$A = \begin{bmatrix} 1 \end{bmatrix} \bullet 3.742 \bullet \begin{bmatrix} 0.2673 & 0.5345 & 0.8018 \end{bmatrix}$$

This equation represents **A** as the product of a column vector of length one times a number times a row vector of length three. Here **A** has one row and the corresponding column vector has one element. In cases where **A** has more rows than the column vector (which comes from **U**) then the expansion would have more elements.

The present application teaches how to produce results other than those of Rockwell. For example, in the case of the one by three matrix **A** discussed above, reducing a rank using an SVD or using other methods can produce three or more non trivial vectors, any of which can be used.

As a matter of mathematics, the matrices **U** and **V** from the SVD are unitary, so their inverses are given by their Hermitian Conjugates. Thus, the equation for the SVD is equivalent to the equation

$$\mathbf{U}^h \, \mathbf{A} \, \mathbf{V} = \mathbf{D}$$

This equation implies that the diagonal matrix **D** results from taking a linear combination of the rows of **A** and also taking a linear combination of the columns of **A**. Notice that multiplying by $\mathbf{U}^h$ takes a linear combination of the rows of **A** and multiplying by **V** takes a linear combination of the columns of **A**.

This equation appears to be inconsistent with the Examiner's statement that "...each row or column of matrix D is a linear combination of corresponding rows or columns of matrix A." (See, e.g., the Office Action mailed 12/19/2005 in 11-1, Page 18, and the current Office Action in 9-1, Page 5, in 9-10, Pages 8, 9, and in 9-20, on Page 10.)

In paragraph 11-3 the Examiner argues that in Rockwell, "The SVD of A is considered for calculating a low-rank approximation to each block A. When M or N is one, the SVD of A still meet the claimed limitation of reducing matrix rank and yield composite sources or testers by selecting the largest elements in the matrix."

Applicant respectfully disagrees, and argues that the SVD of A, when used as taught by Rockwell, does not meet the claimed limitations. If one applies the teachings of Rockwell to an **A** with dimensions of one by p as described above (even though Rockwell did not consider **A** with these dimensions), then using Equation (4) from Rockwell one obtains an expansion for **A** containing only one term:

$$\mathbf{A} = u_1 \; s_1 \; v_1^{\;h}$$

Using the teachings of Rockwell, one might either use this expression to represent A (in which case there is no rank reduction), or one might further truncate the series to give

$$\mathbf{A} = 0$$

When N is greater than one, neither using this exact one-term expansion nor approximating **A** by zero produces "said second set of basis functions comprising a linear combination of a number N of said original basis functions," since no new basis functions are produced. When M is greater than one, neither using this exact one term expansion nor approximating **A** by zero produces "said second set of weighting functions comprising a linear combination of a number M of said original testers," since no new functions are produced.

Applicant notes that in the current Office Action, Examiner stated, "When M is one or N is one, the SVD of **A** still meets the claimed limitation of reducing matrix rank and yield composite sources or testers by selecting the largest elements on the matrix." Applicant argues that simply approximating matrix elements by zero (i.e., zeroing the elements not selected) does not yield the functions that would create the zero matrix elements. Claim 1 recites "to yield a second set of weighting functions" and "to yield a second set of basis functions." When either M or N is greater than one, one of these sets of functions must be different from the first set of functions.

Moreover, Applicant respectfully submits that the Examiner's arguments do not overcome Applicant's arguments that "Rockwell does not teach or suggest that a second set of basis functions and a second set of weighting functions are to be obtained by separate rank reductions." (The Examiner labels this as Applicant's Argument (6)).

The Examiner states that "Rockwell further discloses N is greater than one and M is greater than one (SVD is used to calculate the low-rank approximation to block A and from equation (3) at page 16, left column, each row or column of matrix D is a linear combination of corresponding rows or columns of matrix A)."

Applicant understands Examiner's response to mean that, according to the teachings of Rockwell, the matrix A may have both its first and second dimensions greater than one. However, even if the first and second dimensions are greater than one, Rockwell still teaches a single rank reduction. By contrast, Claim 1 recites a first rank reduction to find a linear combinations of sources and a second rank reduction to find linear combinations of testers.

Rockwell does not teach or suggest that a second set of basis functions and a second set of weighting functions are to be obtained by separate rank reductions. When M and N are both greater than one (see e.g. claim 35), these rank reductions are both non-trivial.

In Rockwell, Equation (4) on Page 17 showed a method for compressing a sub-matrix A. Using A, a pair of interdependent basis functions and testing functions was computed using a single rank reduction and these interdependent basis and testing functions were then used together to compress A. These interdependent basis and testing functions were not computed from different rank reductions or from different data.

Claims 1, 2, and 10 have been amended to clarify that for at least a portion of the transformed equation, using a composite source and a composite tester, that composite source and composite tester were found using data that is at least partially different.

Regarding Claim 1, the cited prior art does not teach or suggest a method of data compression, comprising: partitioning a first set of basis functions into groups, each group corresponding to a region, each basis function corresponding to one unknown in a system of linear equations, each of said basis functions corresponding to an original source; selecting a plurality of spherical angles; using a computer system, calculating a far-field disturbance produced by each of said basis functions in a first group for each of said spherical angles to produce a matrix of transmitted disturbances; reducing a rank of said matrix of transmitted disturbances to yield a second set of basis functions, said second set of basis functions corresponding to composite sources, each of said composite sources comprising a linear combination of a number N of said original basis functions; partitioning a first set of weighting functions into groups, each group corresponding to one of said regions, each weighting function corresponding to a condition, each of said weighting functions corresponding to an original tester; using a computer system, calculating a far-field disturbance received by each of said testers in a first group for each of said spherical angles to produce a matrix of received disturbances; reducing a rank of said matrix of received disturbances to yield a second set of weighting functions, said second set of weighting functions corresponding to composite testers, each of said composite testers comprising a linear combination of a number M of said original testers, wherein at least one of either M or N is greater than one; and transforming said system of linear equations to produce a second system of equations wherein at least a portion of said second system of equations is compressed relative to said system of linear equations and wherein for at least a first portion of said second system of equations, said first portion using said composite sources and said composite testers, at least a portion of said matrix of transmitted disturbances is different from said matrix of received disturbances.

Regarding Claim 2, the cited prior art does not teach or suggest partitioning a first set of basis functions into groups, each group corresponding to a region, each basis function corresponding to an unknown in a system of equations, each of the basis functions corresponding to an original source, selecting a first plurality of angular directions, using a computer system, calculating a disturbance produced by each of the basis functions in a first group for each of the angular directions to produce a matrix of disturbances, using the matrix of disturbances to compute a second set of basis functions, the second set of basis functions

corresponding to composite sources, wherein at least one of the composite sources is configured to produce a relatively weak disturbance from a portion of space around the at least one composite source, partitioning a first set of weighting functions into groups, each group corresponding one of the regions, each weighting function corresponding to a condition, each of the weighting functions corresponding to an original tester, using a computer system, calculating a disturbance received by each of the testers in a second plurality of angular directions to produce a matrix of received disturbances, using the matrix of received disturbances to compute a second set of weighting functions, the second set of weighting functions corresponding to composite testers, wherein at least one of the composite testers is configured to weakly receive disturbances from a portion of space relative to the at least one composite tester; and transforming at least a portion of the system of equations to use one or more of the composite sources and one or more of the composite testers wherein at least a second portion of said transformed system of equations is compressed relative to said system of equations.

Regarding Claim 3, the cited prior art does not teach or suggest that matrix of disturbances is a moment method matrix.

Regarding Claim 4, the cited prior art does not teach or suggest that step of using said matrix of disturbances to compute a second set of basis functions comprises reducing a rank of said matrix of disturbances.

Regarding Claim 5, the cited prior art does not teach or suggest that step of using said matrix of received disturbances to compute a second set of weighting functions comprises reducing a rank of said matrix of received disturbances.

Regarding Claim 6, the cited prior art does not teach or suggest that disturbance is at least one of an electromagnetic field, a heat flux, an electric field, a magnetic field, a vector potential, a pressure, a sound wave, a particle flux, a weak nuclear force, a strong nuclear force, and a gravity force.

Regarding Claim 7, the cited prior art does not teach or suggest that first plurality of directions is substantially the same as said second plurality of directions.

Regarding Claim 8, the cited prior art does not teach or suggest that regions of space around said at least one composite source are far-field regions.

Regarding Claim 9, the cited prior art does not teach or suggest that at least a portion of a region around said at least one composite tester is a far-field region.

Regarding Claim 10, the cited prior art does not teach or suggest a method of data compression, comprising: calculating one composite source as a linear combination of more than one basis function, wherein at least one of said composite sources is configured to produce a relatively weak disturbance in a portion of space related to said at least one composite source, using a computer system, calculating one composite tester as a linear combination of more than one weighting function, wherein at least one of said composite testers is configured to be relatively weakly affected by disturbances propagating from a portion of space around said at least one composite tester, and transforming at least a portion of a first system of equations based on said basis functions and said weighting functions into a second system of equations based on said composite sources and said composite testers wherein for an element of said second equations one of said one or more composite sources and one of said one or more composite testers are computed using at least partially different data, and wherein said second equations are compressed relative to said first system of equations.

Regarding Claim 11, the cited prior art does not teach or suggest that disturbance is at least one of, an electromagnetic field, a heat flux, an electric field, a magnetic field, vector potential, a pressure, a sound wave, a particle flux, a weak nuclear force, strong nuclear force, and a gravity force.

Regarding Claims 12-16, the cited prior art does not teach or suggest that a technique applies not only to antenna and propagation problem, but also to all electromagnetic problems.

Regarding Claim 17, the cited prior art does not teach or suggest that each of said composite sources corresponds to a region.

Regarding Claim 18, the cited prior art does not teach or suggest that second system of equations is described by a sparse block diagonal matrix.

Regarding Claim 19, the cited prior art does not teach or suggest that comprising the step or reordering said sparse block diagonal matrix to shift relatively larger entries in said matrix towards a desired corner of said matrix.

Regarding Claim 20, the cited prior art does not teach or suggest that comprising the step of solving said second system of equations.

Regarding Claim 21, the cited prior art does not teach or suggest that the step of solving said second system of equations to produce a first solution vector, said first solution vector expressed in terms of said composite testers.

Regarding Claim 22, the cited prior art does not teach or suggest transforming the first solution vector into a second solution vector, where the second solution vector is expressed in terms of the weighting functions.

Regarding Claim 34, the cited prior art does not teach or suggest that said transforming said system of linear equations produces a substantially sparse system of linear equations.

Regarding Claim 35, the cited prior art does not teach or suggest that N is greater than one and M is greater than one. Rockwell does not teach or suggest that a second set of basis functions and a second set of weighting functions are to be obtained by separate rank reductions. When M and N are both greater than one, these rank reductions are both non trivial.

Regarding Claim 36, the cited prior art does not teach or suggest said transforming said system of linear equations produces a substantially sparse system of linear equations.

Regarding Claim 37, the cited prior art does not teach or suggest that said matrix of transmitted disturbances is substantially different from said matrix of received disturbances.

Regarding Claim 39 the cited prior art does not teach or suggest the matrix of transmitted disturbances is a rectangular matrix having a different number of rows and columns, and wherein the composite sources are substantially similar in functional form to the composite testers.

Regarding Claim 40, the cited prior art does not teach or suggest that said matrix of received disturbances comprises a moment-method matrix.

Regarding Claim 41, the cited prior art does not teach or suggest that said matrix of transmitted disturbances comprises a moment-method matrix.

Regarding Claim 42, the cited prior art does not teach or suggest that said matrix of received disturbances comprises a moment-method matrix.

Regarding Claim 43, the cited prior art does not teach or suggest that said transforming at least a portion of said system of equations to use one or more of said composite sources and one or more of said composite testers comprises transforming substantially all of said system of equations to use one or more of said composite sources and one or more of said composite testers.

Regarding Claim 44, the cited prior art does not teach or suggest that said transforming substantially all of said system of equations produces substantial sparseness.

Regarding Claim 45, the cited prior art does not teach or suggest that said relatively weak disturbance from a portion of space around said at least one composite source comprises a relatively weak disturbance from a far-field portion of space.

Regarding Claim 46, the cited prior art does not teach or suggest that said relatively weak disturbance from a portion of space around said at least one composite source comprises a portion of space at distances relatively shorter than a distance to other physical regions comprises a relatively more dense portion of space.

Regarding Claim 47, the cited prior art does not teach or suggest that the portion of space at distances relatively shorter than a distance to other physical regions includes a relatively non-intertwining portion of space.

Regarding Claim 48, the cited prior art does not teach or suggest that said relatively weak disturbance from a portion of space around said at least one composite source comprises a portion of space comprising substantially all angular directions in said first plurality of angular directions.

Regarding Claim 49, the cited prior art does not teach or suggest that said portion of space comprising substantially all angular directions in said first plurality of angular directions comprises a relatively more dense portion of space.

Regarding Claim 50, the cited prior art does not teach or suggest that said transforming at least a portion of a first system of equations comprises transforming substantially all of a first system of equations based on said basis functions and said weighting functions into a second system of equations based on said composite sources and said composite testers.

Regarding Claim 51, the cited prior art does not teach or suggest that said second system of equations is substantially sparse.

Regarding Claim 52, the cited prior art does not teach or suggest a system wherein said at least a portion of a first system of equations comprises an interaction between at least one of said basis functions is relatively close to and at least one of said weighting functions.

Regarding Claim 53, the cited prior art does not teach or suggest a system wherein either said one or more composite testers is calculated using a matrix of transmitted disturbances or said one or more composite testers is calculated using a matrix of received disturbances.

Regarding Claim 54, the cited prior art does not teach or suggest a system wherein either one or more composite sources is calculated using a matrix of transmitted disturbances or said one or more composite testers is calculated using a matrix of received disturbances.
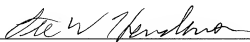
Summary

Applicant respectfully assert that Claims 1-22, 34-37, and 39-54 are in condition for allowance, and Applicant request allowance of Claims 1-22, 34-37, and 39-54. If there are any remaining issues that can be resolved by a telephone conference, the Examiner is invited to call the undersigned attorney at (949) 721-6305 or at the number listed below.

Respectfully submitted,

KNOBBE, MARTENS, OLSON & BEAR, LLP

Dated: November 13, 2006   By: _____

Lee W. Henderson Ph.D.
Registration No. 41,830
Attorney of Record
Customer No. 20,995
(949) 760-0404

3111116
111306